The 50 MHz DX Bulletin

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The 50 MHz DX Bulletin was founded by Harry Schools KA3B. It is dedicated to the understanding and utilization of long distance propagation in the 6-meter Amateur band. This issue, edited and published by Victor Frank, K6FV, is the second of a half-dozen "fill-in" issues with technical information about solar-terrestrial relations and ionospheric propagation. Circulation matters and DX reports should be sent to Victor Frank, K6FV, 12450 Skyline Blvd., Woodside, CA 94062-4541 USA. The Bulletin may be freely quoted, provided that credit is given.

Understanding Solar-Terrestrial Reports

In this issue, we conclude the tutorial by Cary Oler of Solar Terrestrial Dispatch at Stirling, Alberta, Canada, which we started in 1992 May (Volume 3, Issue 5).

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Part II - Interpreting the Reports, Rev. 1.2

2.7. 20-Day Solar Activity Forecast

The 20-day solar activity forecast chart is constructed based on the activity which was observed over previous solar rotations, in addition to the status of the regions which are currently visible on the sun. The intensity, size and number of sunspots in each region are all analyzed (among other things) before this prediction chart is produced.

The plot lines of this chart represent the solar flux levels which are expected to occur throughout the 20-day period covered by the chart. The actual flux values will frequently differ from the actual flux values observed, since predicting the activity of solar regions is still very difficult to do beyond approximately one week. Regions behind the sun may be developing which could significantly alter the shape of the prediction charts. These regions cannot be seen or detected in any way until they approach the eastern limb of the sun. Hence, these solar activity predictions should be used only as a guide. The predictions are generally good at forecasting the times when the solar flux will peak or reach its minimum during a rotational cycle, and this can be of tremendous value to people interested in the level of ionospheric ionization which is proportional to the solar flux.

Flares are not included in this prediction of solar activity. Flares are extremely difficult to predict, even in the short-term. Our knowledge of flares has grown rapidly since the early part of this century. However, our knowledge is still not sufficient to reliably predict the occurrence of major flares over periods in excess of several days. Therefore, this graphical solar activity forecast is limited to a treatment of the solar flux only. As far as flares go, an increasing solar flux generally increases the risk for major flares. The higher the solar flux values, the greater the risk for major flares, since the solar flux is directly related to the number and intensity of active regions on the sun.

2.8. HF Radio Signal Propagation Predictions

This section of the Solar Terrestrial Forecast and Review involves the propagation of high-frequency (HF) radio waves over long-distances. It is a forecast of the expected quality of HF radio signals traveling over long-distances.

The quality of radio signals is divided into several areas. Radio signals which have outstanding strength and stability over long-distances are categorized as excellent. These conditions are rarely observed and occur more frequently over the lower latitudes than the high latitudes. Signals which are abnormally strong and stable over long-distances are classified as very good. These are above-normal conditions when considering the time of year and the state of the solar cycle. Signals which are normal for the current season and state of the solar cycle are given a good classification. These signals are generally stable and relatively strong considering the time of year, but may suffer some minor fading or distortion. Noise may also be somewhat of a factor, but is generally tolerable. When signals fall below the normal quality, they may be categorized as poor.

Poor radio signals over long distances are those which experience moderate to strong fading or flutter, abnormally high levels of absorption, or increased levels of noise (or any combination of the above). Long-distance propagation is still usually possible in these cases, but suffer significantly increased levels of distortion which may hamper attempts at long-distance voice contacts. Very poor radio signal propagation occurs when signals experience severe fading and flutter, high levels of absorption, high levels of noise and high levels of distortion (or any combination of the above). Long-distance communication usually becomes very difficult during these periods and may not be possible at all over some regions. When radio signals are unable to be propagated at all over long distances, or are very poor over short to moderate distances, communication is rated as being extremely poor. This category will only usually be encountered at higher latitudes and during periods of intense geomagnetic storming.

In these forecasts, each day is composed of three 8-hour intervals. These forecasts are also correlated with local time, not UT time as are the geomagnetic forecasts. The first plot line of each day represents the interval between 00 (midnight) and 08 am, local time. The second plot line represents the period between 08 am and 04 pm (or 08:00 to 16:00) local time and so on.

There is one very important note which should be understood by all those who use these forecasts as guides. The local time of attempted communications is a very important factor in long-distance communications due to the diurnal component. This diurnal component is not considered in these forecasts, nor could it be easily incorporated into these charts. The charts are intended to be globally valid. Hence, the obvious diurnal enhancements which occur in differing ways for different regions cannot be included in this global forecast. The person interested in radio communications is already expected to have a knowledge of the diurnal enhancements for his or her region. These charts, therefore, are only intended to aid the interested communications operator in determining the potential times when enhanced radio communications may be possible. It is not intended to reflect the diurnal enhancements which occur, unless the enhancements are significant.

The forecasts are based heavily on recurrent geomagnetic and auroral activity, which are primary factors in determining the quality of radio signal propagation conditions. The intensity of ionization of the appropriate ionospheric layers are also examined when preparing these charts.

This section is separated into three charts for the high latitude regions, middle latitudes and the low latitude regions. Global separation of areas into latitudinal zones is required since the characteristics and quality of radio propagation differ from zone to zone.

To make the best use of these charts, the interested reader is encouraged to follow this procedure. Determine the path endpoint of your signal. That is, determine the location where you want your transmitted signal to be received. This is the path endpoint or destination. Your transmitter location is the startpoint or source. Now draw a great-circle between the startpoint and the endpoint. Next, determine the most northerly geographical coordinates of the great circle connecting the startpoint and the endpoint (we will call this point the northpoint) and note the current local time at the northpoint. After calculating this information, determine what latitudinal zone the path northpoint lies in. Finally, consult the HF propagation prediction charts and select the latitudinal zone chart that corresponds to the latitude of the path northpoint. Using the local time at the path northpoint, select the appropriate day in the chart and examine the plot line which corresponds to that local time. This is the propagation quality that can be expected for that path at that time.

Note, however, that you must also consider the local diurnal signal behavior of your transmission, and the local diurnal signal behavior at the path endpoint in order to determine the diurnal characteristics that should be expected. This information is not given in these charts, but should already be known by the radio operator who is familiar with the diurnal conditions which occur at his or her site. In order to be most accurate, this diurnal component must be considered together with the propagation predictions. Therefore, if your transmission were conducted during a period of time when you know both the startpoint and endpoint signals are enhanced, a truer representation of the propagation quality may be obtained by examining the prediction charts (using the method above) and increasing the quality of propagation up by no more than one level (i.e., from "fair" to "good").

For example, suppose you wanted to communicate between Florida and Great Britain. Florida is a low latitude zone and Great Britain is a middle-latitude zone. Next, we draw a great circle between Florida and Great Britain. If you have no numerical method of doing this, you can approximate the great circle path by stretching a narrow piece of paper on a globe of the world such that the ends of the piece of paper intersect the path startpoint and endpoint (the paper should be bent so that one of its edges lays flat on the surface of the globe). The path that this paper makes on the globe will be curved and represents the great-circle path between Florida and Great Britain. By examining the great circle path, we are able to see that the most northerly geographical position on the path is at Great Britain. Since Great Britain is a middle-latitude region, we consult the middle latitude prediction chart. If you transmitted to Great Britain at 11 am local time on Thursday, the time at the northpoint (which is Great Britain) would be 3 or 4 pm (depending on the season). Since 3 or 4 pm translates to 15:00 or 16:00 in 24-hour clock

format, you would examine the middle plot line of the chart for Thursday. Note, however, that the northpoint local time of 15:00 or 16:00 falls close to the boundary between the middle plot line and the last plot line for Thursday. Since this is the case, a more accurate representation of conditions may be obtained by considering a mix of the middle plot line with the last plot line (possibly averaging the two plot lines).

An important consideration to note when attempting to use these charts is the time of sunrise and sunset between the startpoint, endpoint and northpoint. Since dramatic changes in ionospheric characteristics occur during these periods, any transmission which crosses the sunrise or sunset boundaries on its way to the endpoint will experience correspondingly dramatic changes in behavior and quality. These charts do not (and could not) account for these variations in signal quality. The sunrise and sunset ionospheric anomalies are considered diurnal components in this discussion.

In many cases, the great-circle path of the signal may travel over more northerly latitudes than the startpoint and endpoint. For example, a transmission between central Canada and Great Britain may result in a great-circle path that passes through the high-latitude regions before reaching Great Britain, even though both the startpoint and endpoint are middle-latitude stations. In these cases, the most northerly position of the great-circle path should be used.

If the signal path (or the two path endpoints) are near the boundaries of two latitudinal zones, a mix of the propagation predictions for the two latitudinal zones may be required to yield a more accurate representation of propagation conditions. For example, if a transmission were conducted between Denver and Atlantic City, which both border as low and middle latitude locations, both of the charts for the low and middle latitude zones should be analyzed and mixed in order to determine the conditions which might be expected over that path. Since the distances in this latter example are relatively small (compared to the latter examples), the northpoint of the signal path will not significantly affect propagation conditions. This is why we only examined the latitude of the startpoint and endpoint. For greater distances, the northpoint must be considered.

2.9. VHF Propagation Prediction Charts

The prediction of potential VHF DX is not as simple as it is for HF. VHF signals have properties which are not usually affected by the ionospheric layers. In our context, "VHF" will be considered those frequencies ranging from about 50 MHz to 300 MHz. For information regarding the major types of VHF propagation which are possible, consult part I of this document.

A great deal of information can be extracted from the VHF prediction charts. Information pertaining to HF communications is also embedded in these charts. As was done for the HF prediction charts, the VHF predictions are separated into three charts; one for each of the major latitude zones.

The upper part of the chart forecasts the quality of potential distant VHF signals. It does not depict the quality of locally transmitted VHF signals. This is an important point to remember. Locally transmitted "line of sight" signals can not be affected and are not affected by geomagnetic activity, auroral activity, or SIDs. Therefore, only the distant signals which can be affected by these phenomena are considered in these charts.

As was the case with the other propagation prediction charts, the VHF prediction charts are separated into groups of three 8-hour daily intervals. The reference of time used in these charts is LOCAL time, not UT time. That is, the first line of each day in these charts represents the period between local midnight and 8 am local time.

To use these charts, simply determine what time it is locally and examine the appropriate day in the charts and the appropriate plot line within that day. The top portion of the prediction charts define the quality of VHF signals which can be expected over larger distances. The bottom chart describes the probability of experiencing conditions capable of supporting VHF DX. Both charts use the same reference of time (local time).

The SID ENHANCEMENT chart at the upper right-hand corner describes the probability of a SID (sudden ionospheric disturbance) temporarily enhancing VHF communications. The probability of SID enhancements increases with solar activity, but decreases with increasing latitude. This data is also of value to the HF radio operator, since SIDs almost always produce short-wave fades (SWFs) which can disrupt HF communications. Since SIDs are sporadic and very unpredictable (due to the unpredictable nature of solar flares), they are predicted as percentages in these charts. SID-related VHF enhancements do not occur on the dark-side of the earth. Neither do SWFs. Therefore, these SID prediction charts only apply to those locations which are still well illuminated by the sun.

The AURORAL BACKSCATTER prediction charts are of value to the VHF radio operator. Auroral backscattering (as was described in part I of this document) is possible at VHF frequencies during times of increased geomagnetic and auroral activity. These prediction charts define the approximate probabilities of VHF propagation via auroral backscatter over the various latitudes. VHF signals which are propagated via aurora can travel fairly large distances. Propagation via aurora is therefore considered a potential method of DX on VHF frequencies. It is, however, a fairly local and sporadic phenomena and is usually not a widely-encountered form of propagation until auroral and geomagnetic activity reaches significant storm levels.

To make use of these VHF charts, simply consult the appropriate plot lines according to what day it is and the local time. The HF operator may be able to determine what days will prove less reliable as far as day-time propagation goes by examining the probability for SID related SWFs. Most SWFs, however, are only temporary and do not pose a significant threat to most HF operators, unless the flares which produce them are particularly intense.

2.10. Auroral Activity Predictions

Auroral activity is predicted for the three major latitude zones identified earlier. Since the auroral oval itself is situated within the high-latitude zone, the high latitudes will naturally experience significantly more auroral activity than the middle and low latitudes.

The prediction charts for auroral activity are most useful to those people interested in either observing auroral activity, propagating radio signals using aurora, or for

people interested in determining the extent of magnetic fluctuations occurring near areas of auroral activity.

Since auroral activity migrates equatorward during geomagnetic storms, locations which may usually be outside of the auroral zone itself may occasionally find themselves inside the auroral zone during periods of increased geomagnetic activity. Likewise, as auroral activity shifts equatorward, low latitudes may be able to begin spotting the activity.

These prediction charts can be used to determine whether or not potential auroral activity may be intense enough to be seen at low latitudes, or whether auroral activity will be dull and inactive or bright and very active.

To use the charts, simply examine the appropriate chart (ex. if you're a middle latitude location, examine the middle-latitude chart) and select the column on the day you are most interested. The first plot line of each day represents the evening twilight period. This is the period between when the sun sets and before the sky gets completely dark. The second plot line represents the midnight sector where the sky remains completely dark (excluding effects of lunar phase). The last plot line is the morning twilight period and represents the time when the sky just barely begins to brighten until the sun rises.

The phase of the moon is not taken into consideration in these charts. The moon can have a profound effect on the visibility of auroral activity, but does not affect auroral activity itself. That is, just because the moon may be blocking out light of auroral activity does not mean that auroral activity is not in progress. Indeed, intense auroral storms can occur during a full moon as easily as they can during new moons. Therefore, these charts represent the occurrence of auroral activity regardless of lunar phase.

The intensity of auroral activity is measured according to several parameters. Each of these parameters are discussed in the Glossary of Solar Terrestrial Terms. In their most basic form, the parameters (low, moderate, high, etc.) may be considered the brightness of auroral activity during dark-sky conditions (i.e., periods of new moon). However, actual visual movements, color changes and aerial extent are also considered when classifying auroral activity in these prediction charts.

3. Monthly Solar Terrestrial Review

Every month, statistics and information regarding solar and terrestrial activity for the preceding month are gathered and compiled into a document called the Monthly Solar Terrestrial Review. This document contains not only information regarding the nature of activity of solar and geophysical phenomena during the preceding month, but also includes a six month solar cycle outlook. This can be of great value to the radio operator who is interested in determining what conditions might be like six months down the road. It can also be of interest to the astronomer who may enjoy searching for auroral activity or solar flares.

In addition to the written summary, a statistical summary of the previous month is given in tabular form, summarizing all of the major solar parameters (i.e., solar flux, sunspot numbers, active region sizes, numbers and types of flares, etc.).

This report is intended to serve as a general summary regarding activity and phenomena encountered during the previous month. It can provide some interesting results if data from the report is charted or graphed or statistically analyzed.

4. Geomagnetic Storm Alert

This alert is posted over the nets whenever magnetic storm conditions reach or exceed minor storm levels over middle latitudes. This alert may be preceded by a warning if a magnetic storm is expected to occur but hasn't yet begun.

These alerts always summarize the current level of activity and may also include descriptions of outstanding geomagnetic activity occurring prior to the time the alert was issued.

A brief textual forecast of the expected geomagnetic activity is also included with these reports. This effectively serves as an intermediate forecast which can be of value during geomagnetic storm periods when conditions change rapidly.

Full HF and VHF summaries are included with the storm alerts and all following storm information updates. This information is of value to those who rely on ionospheric and/or auroral-related communications.

5. Availability of Additional Services

Solar Terrestrial Dispatch also supplies other services not mentioned in this document, which may be of interest or value to certain individuals or organizations. One of the additional services provided are GIC forecast and warning services for individuals or organizations requiring predictions of possible Geomagnetically Induced Currents caused by magnetic storming over the high and/or middle latitudes. Forecasts are produced on a weekly basis, and warnings are issued whenever conditions (or expected conditions) warrant.

For more information on this or other services not mentioned in this document, feel free to contact Solar Terrestrial Dispatch by writing to: Solar Terrestrial Dispatch, Box 357, Stirling, Alberta Canada, T0K 2E0. Alternatively, for those of you with access to one of the large electronic networks, you may contact: oler@hg.uleth.ca for more information (this is an Internet address).

Significant enhanced services will soon be available from Solar Terrestrial Dispatch for individuals and researchers interested in obtaining up-to-the-minute solar terrestrial data (ex. x-ray data, proton data, geomagnetic data, flare-related data, ionospheric data, etc). For more information or questions regarding the availability of these or other services, consult Solar Terrestrial Dispatch as given above.

A recent addition to the services provided by the Solar Terrestrial Dispatch is the Solar Terrestrial Dispatch computer BBS. This is a public-access BBS system which regularly obtains fresh forecasts and data sets. A great deal of additional data is available to registered users of this BBS, including ionospheric data (total electron content data, MUF forecasts, short-wave fade forecasts and much more), geomagnetic data (real-time geomagnetic data less than 2 minutes old, indices and forecasts, etc) and access to other solar forecasts and data sets (such as real-time x-ray plots, proton plots, polar cap absorption plots, etc). These are all available to registered users of the BBS. Registration information may be found by calling the BBS. The phone number is: (403) 756-3008. Baud rates of 300, 1200

or 2400 baud are accepted. The communications protocol is 8 bit words, 1 stop bit and no parity. Unregistered users are able to access all of the information which is available over the Internet, Bitnet and Usenet networks.

6. Concluding Remarks

The solar terrestrial reports which are posted over the networks contain a great deal of information. Understanding them may take some time. Applying the information contained in them may take even longer. This document (part I and II) was developed to help explain the nature and format of these reports. It was also developed to help those who are interested in interpreting and applying the information contained in the reports.

It is hoped that this document will help those who are interested in better understanding the solar terrestrial reports. Questions and/or comments are welcome. If any further explanations are required which have not been adequately covered in this document, feel free to send an inquiry to "oler@hg.uleth.ca" or leave a message to the "Sysop" on our BBS.

We have learned a great deal over the years regarding the impacts of solar activity on our terrestrial sphere. But there is still a great deal more we need to learn before we can expect to master the art of predicting the impacts of solar activity on the earth. Our curiosity drives us further and our lust for knowledge quickens our pace of learning. With developments of new devices and technologies, we are steadily edging closer to understanding both our terrestrial environment and the vast environment of space. The educational institutions and research organizations are the backbones of our knowledge and growth. We must therefore respect these institutions, support them, and encourage them so that our body of knowledge is able to continue expanding into the limitless realm of science.

Errata—Footers

It appears we have been somewhat careless with our footers. Footers? They are the lines at the bottom (foot) of each page (except page 1). We forgot to change the template between the 1993 May and 1992 September issues (which were sent together last month). As a result, our first makeup issue was footed as 1993 May instead of 1992 September. Looking through our back issues, I see this is not an isolated occurrence. 1992 January 1 was footed January 1, 1991 and 1993 January 15 was footed as 1992 January 15. For those of you who care, make the necessary corrections.

1992 Solar-Geophysical Data

The last time we published quarterly graphs of sunspot number, 10.7 cm radio flux, proton flux, and A index, was in the 1992 January 1 issue. It covered the period between 1991 September 1 and 1991 November 30, and the date was in terms of day number for the year.

We've got three more for you this month, which will catch us up to date. The first, labeled Winter 91-92 starts with 1991 December 1, which is labeled day -30. The second graph, labeled Spring 1992 starts with day 61 (1992 March 1—remember this was a leap year). The third graph, labeled Summer 1992, starts with day 153 (1992 June 1). Grid lines are drawn every 7 days.

The data came from Solar Terrestrial Dispatch. I wrote a program to convert their daily summaries of solar geophysical activity to tables which could be read by a plotting program.

The plotting program, however, is not smart enough to mix the three types of plots I have presented. That involves old-fashioned cut and paste.

The top plots contain three measures of solar activity, daily sunspot number, daily 10.7 cm radio flux, and the average of the past 90 days of the same.

The middle plot shows the flux of protons (from the sun) of energy ≥10 Mev observed at geostationary altitude.

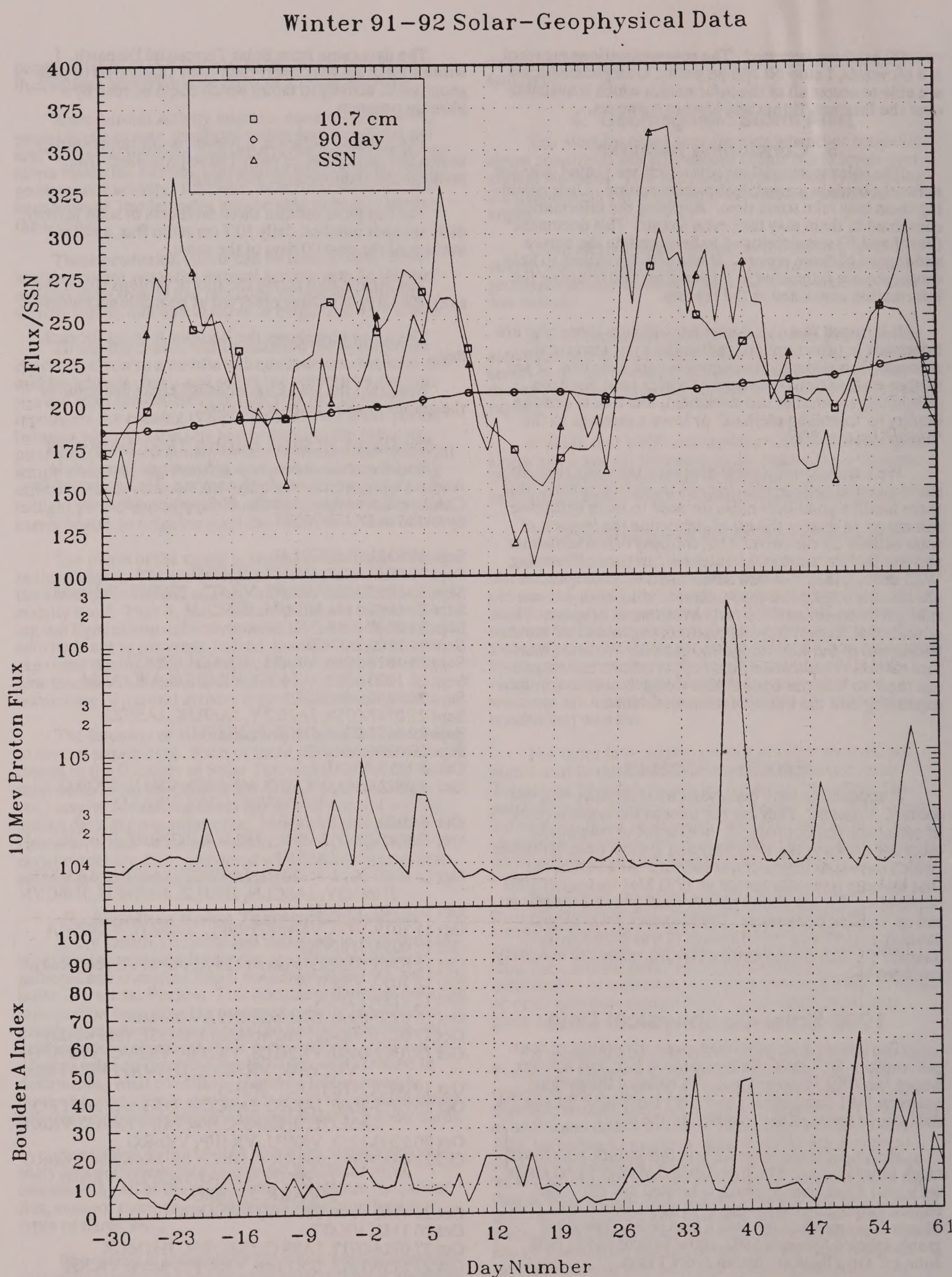
The lower plot shows the Boulder A-index for each day.

Note that the scales have changed between some of the graphs as solar activity declined.

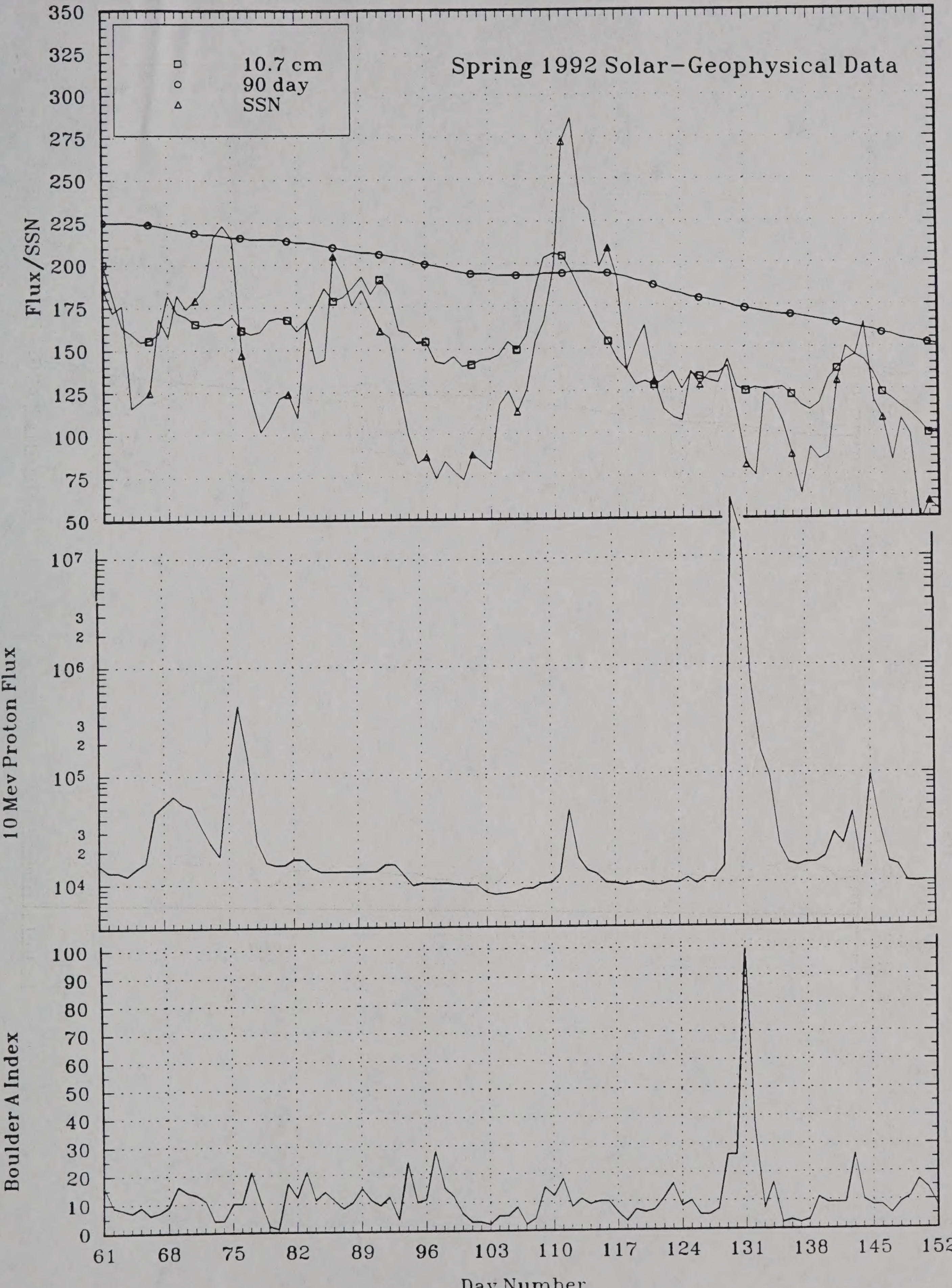
6m DX at HL9UH during 1992 Sept-Oct

To fill out this issue, here are excerpts from Louie Anciaux's log, which he kindly sent me. He has moved to Chinhae, Korea from Manila, Philippines, where he operated as DU/KG6UH.

Sept 19 0221, JM6EYL/6
Sept 19 0928-0938, VK4TL, JE6JYT
Sept 20 1015-1035 VK4FP, VK4TL, P29BPL (hd weak)
Sept 20 1107-1111 VK4JH, JK6ERV
Sept 21 0900-0915 DX1 beacon
Sept 21 1109, P29CW
Sept 25 1022-1056, VK4TL, VK4TH, P29CW
Sept 26 1020-1057, VK4DO, VK4BRG, VK4ALM
Sept 26 1158, VK8RH
Sept 27 0747-0758, JA2BZY, JA6RJK, JA5FZJ
Sept 29 0657-0706, JH0INP, JK1PUI
Sept 29 0954, VK4TL
Oct 2 1117, VK4JH
Oct 4 0642-0652, VK6RO, VK6WD, VK6JJ, VK6SQ, VK6ZRY, VK6YU, VK6AO
Oct 6 0950, H44/JA1OEM
Oct 9 2345-2357, JA8RC, JF2AIA, JG2BRI, JR6KJL, JA5FFJ
Oct 10 0000-0014, JG2BRI, JA7WSZ, JA8TSG, JA3JTG, JH6CQY, JA8CLN, JF6JLZ, JH8NKN, JH6CYN
Oct 10 0240, VK4JH
Oct 11 1019-1056, VK4FP, P29PL, VK8RH, VK8ZMA
Oct 12 0031, JH6VXP
Oct 12 0740, S21ZE in on 50.115 S1 out of SE (no QSO).
Oct 12 1030, VK9WW
Oct 12 1139, P29JA
Oct 16 0750-0900, DX1 bcn, 50 JA's worked
Oct 17 0255, VK4JH hrd working JA3EGE (hrd weakly)
Oct 18 0342-0450, VK2GLS, VK2QF, VK2VC, VK2APG, VK2TBW, VK3BRZ, JH6VXP, 46.24 MHz.
Oct 19 0803, N7ET/DU7 (PJ19)
Oct 20 0915-1008, JA8RC, JA9CGR, DX1 bcn, JR7TEQ, JA3EGE, JH0BQX, JF4CMI, VK4SIX, VK6JQ
Oct 20 1200-1252, VK6RJ, VK4FP, VK6RO
Oct 21 0832-0952, JS2KXY, JA0GLM, JA4XRN, VK6RO JA9BOH, VK6RJ, JA5FDJ, VK6JJ, JH6AER, JE1BMJ
Oct 21 1140-1144, P29CW, VK3AMK
Oct 26 1133, VK4FP
Oct 27 0914-0917, JA8RC, JR6QBM, JH1MCX
Oct 27 1159-1213, DX1 bcn, VK8, P29 weak, VK2QF
Oct 29 1119-1122, VK4JH



Winter 91–92 Solar–Geophysical Data
10.7 cm
90 day
SSN
Flux/SSN
400
375
350
325
300
275
250
225
200
175
150
125
100
10 Mev Proton Flux
10^6
10^5
10^4
Boulder A Index
100
90
80
70
60
50
40
30
20
10
0
−30 −23 −16 −9 −2 5 12 19 26 33 40 47 54 61
Day Number



Spring 1992 Solar-Geophysical Data
10.7 cm
90 day
SSN
Flux/SSN
350
325
300
275
250
225
200
175
150
125
100
75
50
10 Mev Proton Flux
10^7
10^6
10^5
10^4
3
2
Boulder A Index
100
90
80
70
60
50
40
30
20
10
0
61
68
75
82
89
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103
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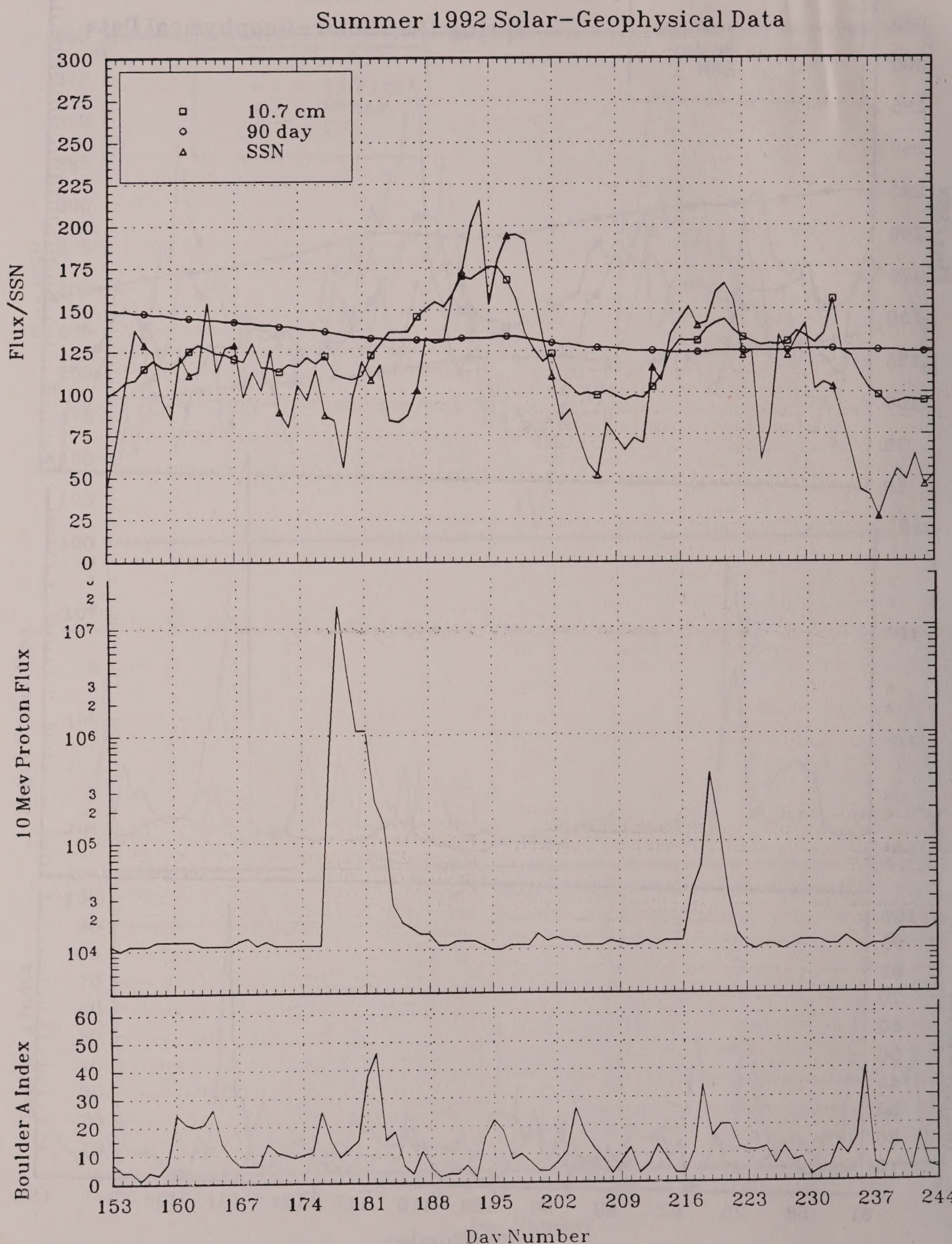
117
124
131
138
145
152
Day Number



Summer 1992 Solar-Geophysical Data
10.7 cm
90 day
SSN
Flux/SSN
10 Mev Proton Flux
Boulder A Index
Day Number